

CLAIMS

What is claimed is:

1. A method of forming a feature pattern in a photosensitive layer, comprising:
forming the photosensitive layer on a substrate;
providing a first mask having a first opaque area thereon;
performing a first exposure process with a first dose using the first mask to form a first unexposed image in the photosensitive layer;
performing a second exposure process with a second dose to expose sidewalls of the first unexposed image, wherein a second unexposed image is formed in the photosensitive layer; and
developing the photosensitive layer with a development process to form the feature pattern and to create slim features having smaller widths than those which would result in developing the photosensitive layer of the first unexposed image.
2. The method as set forth in claim 1, wherein:
during the first exposure sidewalls of the first unexposed image receive at least a portion of the first dose; and
during the second exposure sidewalls of the first unexposed image in addition to having received at least a portion of the first dose also receive at least a portion of the second dose.
3. The method as set forth in claim 2, wherein:
at least one sidewall receives an amount of the first dose which is below a threshold level required for formation of a corresponding one of the slim features, but receives an amount of the second dose to raise a cumulative dose of radiation thereof above the threshold level so that during the development process a corresponding slim feature is formed.
4. The method as set forth in claim 3, wherein the at least one sidewall comprises a plurality of sidewalls; and
the correspond slim feature comprises a plurality of slim features.

5. The method as set forth in claim 2, wherein the second dose is equal to the first dose.
6. The method as set forth in claim 2, wherein the second dose is not equal to the first dose.
7. The method as set forth in claim 2, wherein the second exposure is performed using a pattern equivalent to that of the first mask.
8. The method as set forth in claim 2, wherein the second exposure is performed using the first mask.
9. The method as set forth in claim 2, wherein the second exposure uses a mask with a plurality of patternless areas.
10. The method as set forth in claim 2, wherein the second exposure uses a mask without a pattern.
11. The method as set forth in claim 2, wherein the second exposure is performed without a mask.
12. The method as set forth in claim 2, wherein:
 - the first opaque area has a first dimension $d1$; and
 - the performing of the second exposure process is preceded by providing a second mask having a second opaque area thereon, the second opaque area having a second dimension $d2$.
13. The method as set forth in claim 12, wherein:
 - during the first exposure sidewalls of the first unexposed image receive at least a portion of the first dose;
 - during the second exposure sidewalls of the first unexposed image in addition to having received at least a portion of the first dose also receive at least a portion of the second dose; and
 - at least one of the sidewalls receives an amount of the first dose which is below a threshold level required for formation of a corresponding one of the slim features, but receives an

amount of the second dose to raise a cumulative dose of radiation thereof above the threshold level so that during the development process a corresponding slim feature is formed.

14. The method as set forth in claim 13, wherein:
the at least one sidewall comprises a plurality of sidewalls; and
the corresponding slim feature comprises a plurality of slim features.
15. The method as set forth in claim 12, wherein the first exposure process and the second exposure process are performed in either order.
16. The method as set forth in claim 12, wherein the first opaque area comprises a plurality of opaque blocks.
17. The method as set forth in claim 12, wherein the second opaque area comprises a plurality of opaque blocks.
18. The method as set forth in claim 12, wherein the second dimension d2 is larger than the first dimension d1.
19. The method as set forth in claim 12, wherein the second dimension d2 is equal to the first dimension d1.
20. The method as set forth in claim 12, wherein the second dimension d2 is smaller than the first dimension d1.
21. The method as set forth in claim 12, wherein the second dose is smaller than the first dose.
22. The method as set forth in claim 12, wherein the second dose is equal to the first dose.
23. The method as set forth in claim 12, wherein the second dose is larger than the first dose.

24. The method as set forth in claim 12, wherein the first exposure process comprises an off-axis illumination.
25. The method as set forth in claim 12, wherein the first mask and the second mask comprise at least one of a binary mask, a phase shift mask, and a chromeless mask.
26. The method as set forth in claim 12, wherein the first exposure process and the second exposure process are performed with at least one of a projection exposure tool and a contact printing tool.
27. The method as set forth in claim 12, wherein the first mask and the second mask are formed of different types of materials.
28. The method as set forth in claim 12, wherein the photosensitive layer comprises a plurality of layers of photosensitive material.
29. The method as set forth in claim 12, wherein the first opaque area and the second opaque area are located on the same mask.